

RECOMMENDED TRUNK SEWER

4.1 RECOMMENDED ALIGNMENT

Based on the outcome of the analyses summarized in Chapter 3, a recommended alignment has been selected as shown in Drawings C-001 through C-009 located at the end of this Chapter. Also shown on these drawings is the approximate location of the junction structures and manholes. It is recommended that the actual location of these structures be finalized during final design with input from City staff. Table 4.1 below presents a summary of the recommended trunk sewer.

Table 4.1 Summary of the Preferred Alignment Stevens Creek Basin Trunk Sewer City of Lincoln, Nebraska		
Phase	Pipe Size	Approximate Length (ft)
I	84", 72", 66" and 60" Ø	6,376
II	66" Ø	7,509
III	60" Ø	10,895
IV	24" Ø	9,022
V	54" Ø	13,843
VI	48" Ø	6,300
VII	42" and 36" Ø	5,270
VIII	36" and 30" Ø	11,865
IX	30", 24", 21", and 18" Ø	7,205
Total		78,285

4.2 HYDRAULIC MODELING

A hydraulic model of the recommended trunk sewer alignment was run to account for the minor changes in pipe size, slope and location from that previously modeled. The model output is shown in Appendix F and is shown graphically in Figure 4.1. Additionally, a profile of the recommended alignment was prepared as shown in Figure 4.2.

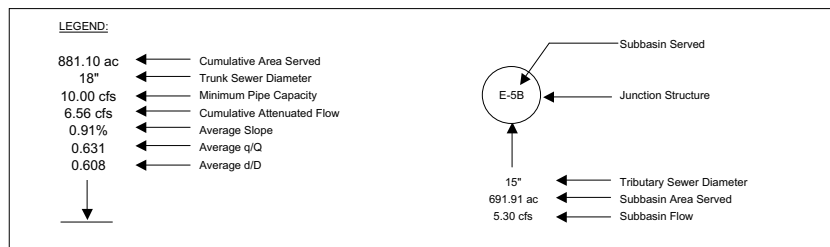
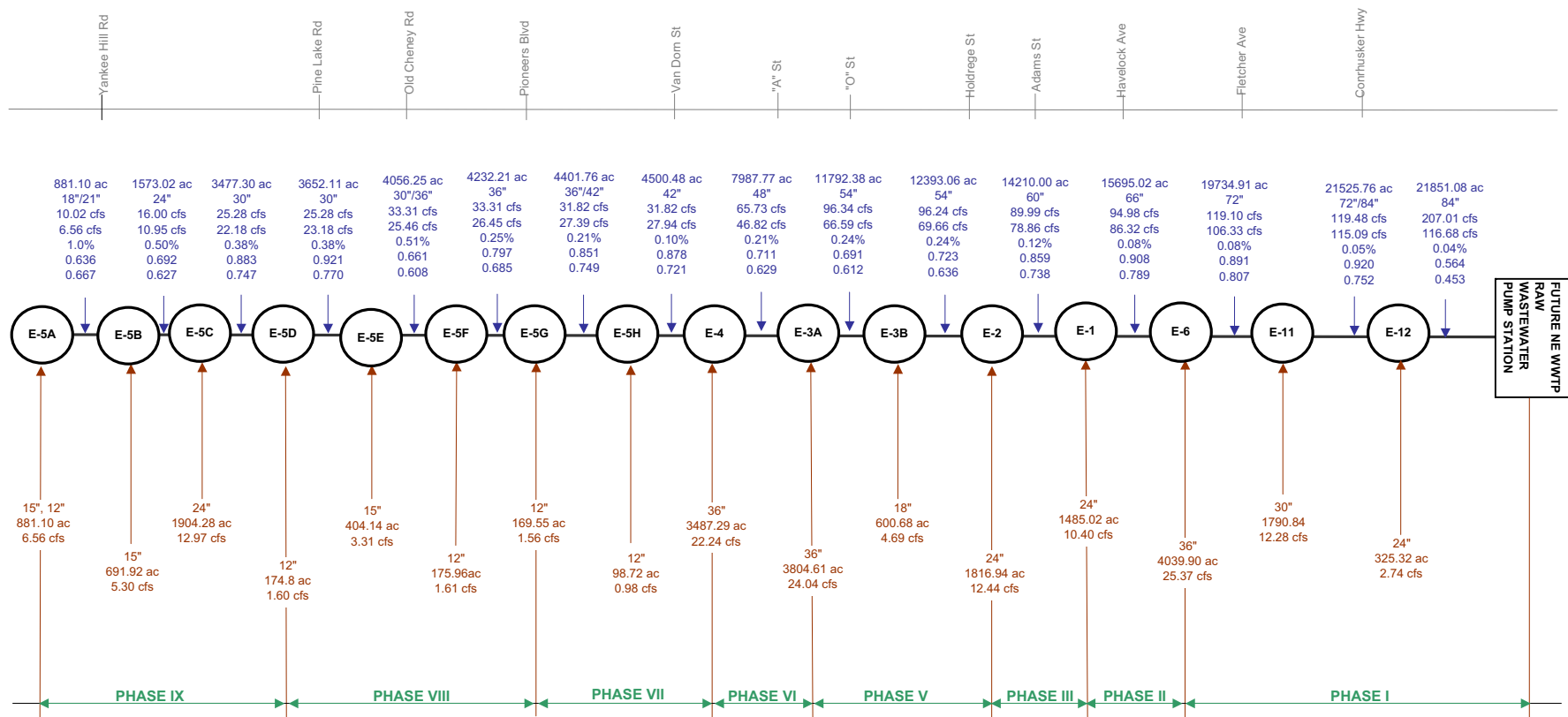


Figure 4.1
Trunk Sewer Diagram
STEVENS CREEK BASIN TRUNK SEWER
CITY OF LINCOLN, NEBRASKA

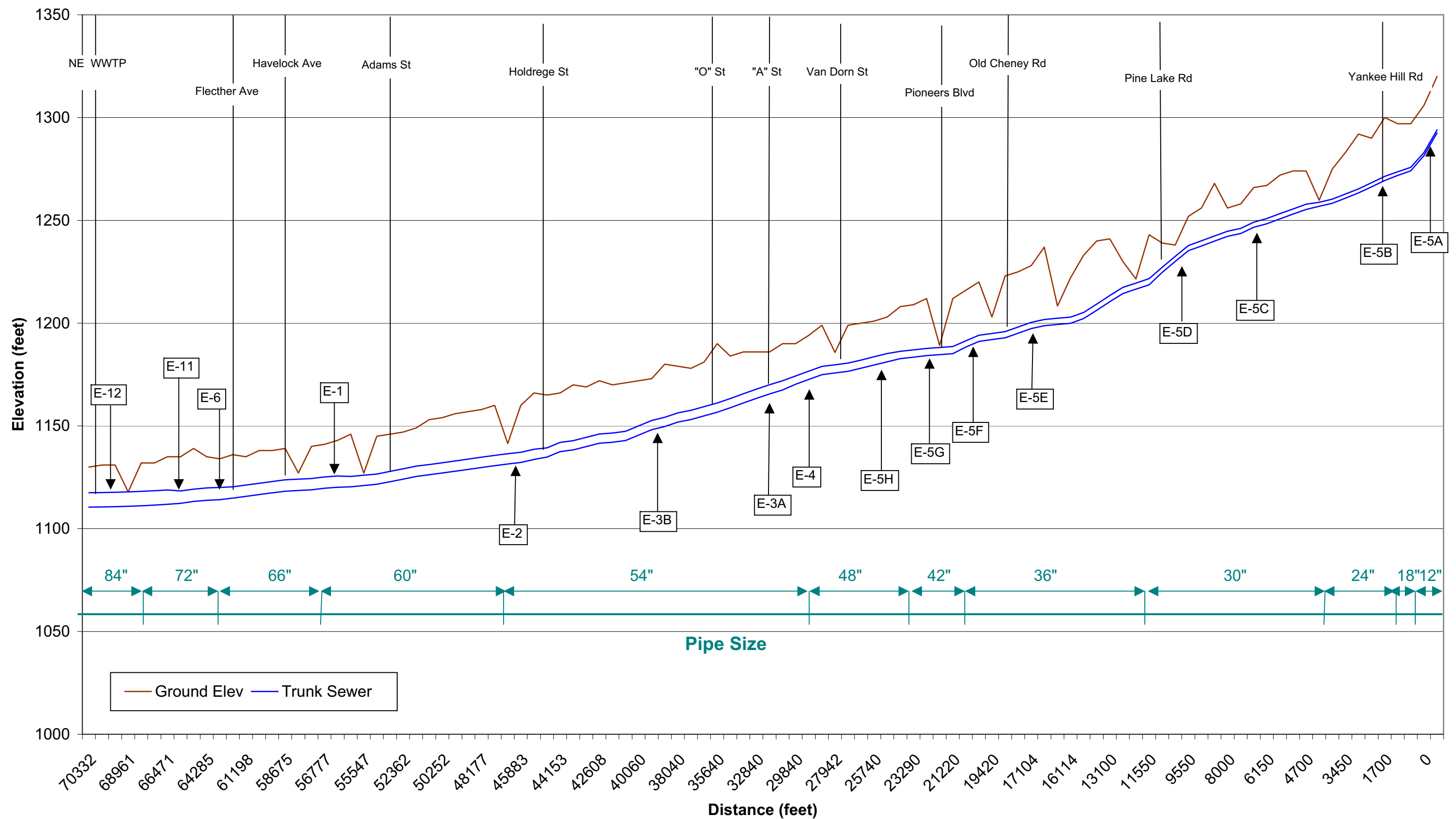


Figure 4.2
Selected Alignment Pipe Profile
 STEVENS CREEK BASIN TRUNK SEWER
 CITY OF LINCOLN, NEBRASKA

4.3 SUMMARY OF SERVICE AREA

4.3.1 Recommended Trunk Sewer

As previously discussed and shown in Figure 3.1, the recommended trunk sewer is sized to serve the Tier I and Tier II areas on the west side of Stevens Creek as well as the Tier II areas located on the lower eastside of Stevens Creek regardless of which side of the creek the trunk sewer may be located.

4.3.2 Future Eastside Service (Tier III)

Two methods to provide future service to the Tier III areas on the east side of Stevens Creek have been identified. The first method is to install a second trunk sewer on the east side of the creek. This sewer would then cross Stevens Creek near Fletcher Avenue. At this location, the two trunk sewers would parallel each other to the NE WWTP. The size of this trunk sewer is estimated to be 66-inch in diameter and would transport the flows from subbasin E-6, E-7, E-8, E-9, and E-10. This pipe size was determined based on preliminary hydraulic modeling included in Technical Memorandum No. 3 (Appendix C).

The second method of providing service to the east side of Stevens Creek is to install a trunk sewer that will collect the wastewater from subbasin E-7, E-8, E-9, and E-10. This trunk sewer would then cross Stevens Creek near Murdock Trail and parallel the west side trunk sewer to the NE WWTP. The flows from subbasin E-6 would then cross Stevens Creek at Fletcher Avenue. This concept has been previously evaluated in Technical Memorandum No. 3 (Appendix C).

4.3.3 Regent Heights Sewer

The existing Regent Heights sewer flows east on the north side of Adams Street before turning north and meandering to the Murdock Trail near the Events Center. The City has expressed a desire to intercept the flows in this sewer and direct it to the Stevens Creek Trunk Sewer. There are several possible locations where this diversion can take place. The recommended location is shown in Drawing C-002. Based on recent field survey there is over 20 feet of fall from the invert of the Regent Heights sewer to the invert of Junction Structure E-1 at the location shown.

4.4 RIGHT OF WAY REQUIREMENTS

4.4.1 Permanent Easement

The City will require that the sewer be constructed in a dedicated easement. This easement will allow the City to have access to the sewer for repairs and maintenance. With the exception of Phase I and possibly Phase II, the width of the permanent easement will

generally be 40 feet. The width of the Phase I and II easements will be wider to accommodate the addition of a future parallel pipe to serve the east side Tier III areas.

4.4.2 Temporary Easement

In addition to the need for permanent easement, temporary easement will be required. This temporary easement will be used to provide the needed construction space for the Contractor to perform his work. The temporary easement will be located adjacent to and run parallel with the permanent easement. The width of the temporary easement will vary but it is envisioned that it will vary from 50 wide in the southerly reaches to 160 feet wide in northerly reaches. The combination of the permanent and temporary easement will provide the needed room for the construction of the trunk sewer.

4.5 PRELIMINARY DESIGN

4.5.1 Aerial Mapping

During the time when the preliminary hydraulic modeling and alternative alignment analysis was in progress, low level aerial photography was scheduled and completed. This photography was used to generate a 400 ft wide strip map of the recommended alignment with one-foot contours. Control for the mapping was established using City benchmarks. The aerial photography was orthographically corrected and digitized.

4.5.2 Plan and Profile Drawings

With the updated aerial survey and mapping in hand, preliminary plan and profile drawings were generated for the trunk sewer including the subbasin E-2 sewer. These drawings were prepared at a horizontal scale of 1-inch equals 50 feet and a vertical scale of 1-inch equals 5 feet. The ground profile was generated using Geopack software. A ground survey was conducted at selected creek and drainage channel crossings to verify the electronically generated profile in these areas.

During the preparation of the preliminary plan and profile drawings minor modifications to the alignment and pipe size and slopes were made. These changes were limited primarily to minor adjustments at creek and drainage channel crossings. In addition, minor modifications were made at road crossings to avoid existing utilities, and other improvements. Junction structures and manhole have been located on the preliminary drawings with coordinates and the pipeline stationing. The preliminary plan and profile drawings that include the minor modification discussed above reflect the recommended trunk sewer. Preliminary plan and profile drawings are included as Volume 2 of this report.

4.6 PROBABLE OPINION OF ESTIMATED COSTS

4.6.1 Methodology

The preliminary opinion of probable estimated costs developed as part of this project represent an order of magnitude cost estimate. An order of magnitude estimate is considered a reconnaissance level estimate. Order of magnitude costs may be estimated using cost-capacity curves, scaling factors, ratios, as well as information from other projects. An order of magnitude cost would be expected to have an associated accuracy of + 50 to - 30 percent. All of the cost estimates presented herein are based on the first quarter of the year 2004 values. The estimated costs are to be evaluated as an approximate because they are developed without detailed design data. This opinion of cost varies from those previously stated. This is due to many factors including:

- Higher level of mapping accuracy.
- Revised pipe size.
- Depth of pipe.
- Known number of junction structures and manholes.
- Revised quotes from suppliers.
- Recent conversations with Contractors.

All sitework quantities associated with each reach were added up to generate the unit cost for each of the sitework line-items that were used throughout the respective phase detailed cost estimate. The roads and stream crossings were assumed to be constructed using tunneling methods. The permanent easement was set as 40-ft wide and the temporary easement was set at 160-ft wide. The cost for the junction box was based on 12-inch thick sidewalls, 12-inch thick slab-on-grade, and a 6-inch concrete cover. The piping cost provided is based on ASTM C-76 class 5 RCP in open trench.

4.6.2 Assumptions and Allowances

The Probable Opinion of the Estimated Project Costs for the alternatives presented incorporate the following allowances:

- Fifteen (15) percent estimating contingency.
- Twenty (10) percent for engineering and administrative fees.
- Eight (8) percent for general conditions.
- Five (5) percent for escalation.

Due to the increase in the level of detail at this point in the project, these allowances are lower than those used in the preliminary analyses.

The estimate does not include any allowance for the identification or mitigation of hazardous materials, on the costs associated with the discovery and remediation/preservation of historical or cultural items.

4.6.3 Probable Opinion of Estimated Costs

Using the above stated assumptions and allowances, the opinion of estimated costs as well as the size and length of pipe for each phase is outlined in Table 4.2. The backup data for the probable opinion of estimated costs is located in Appendix G.

Table 4.2 Probable Opinion of Estimated Project Costs Stevens Creek Basin Trunk Sewer City of Lincoln, Nebraska	
Phase	Estimated Project Costs
I	\$8,136,000
II	\$6,032,000
III	\$9,893,000
IV	\$2,097,000
V	\$10,047,000
VI	\$3,384,000
VII	\$3,481,000
VIII	\$6,944,000
IX	\$2,807,000
Totals	\$52,821,000

4.7 IMPLEMENTATION PLAN

4.7.1 General

Two general implementation plans have been developed for this project. It should be noted that the actual implementation plan for the Stevens Creek Trunk Basin Sewer will be dynamic in nature. The two primary drivers will be the demand for service in the basin, and the availability of funds to construct the trunk sewer.

4.7.2 Base Plan

The base implementation plan is developed using the criteria identified in the Lincoln and Lancaster 2025 Comprehensive Plan. Using this criteria the Tier I areas would receive service within the next 25 years. Making the assumption that the trunk sewer would need to be in place prior to the end of the 25 years, a 12-year construction schedule was assumed. During this time the first five phases of the trunk sewer from the NE WWTP to Junction Structure E-3A located near Stevens Creek and "A" Street would be constructed. The estimated cost for the Tier I improvements is \$36,205,000 as shown in Table 4.3 below.

Table 4.3 Tier I Implementation - Estimated Costs Stevens Creek Basin Trunk Sewer City of Lincoln, Nebraska	
Phase	Estimated Project Costs
I	\$8,136,000
II	\$6,032,000
III	\$9,893,000
IV	\$2,097,000
V	\$10,047,000
Totals	\$36,205,000

Service to the Tier II areas would take place after 25 years and would result in providing service to the remainder of the west side of the basin and subbasin E-6 located on the lower eastside of the Stevens Creek Basin. This will complete the remainder of the trunk sewer from "A" Street to Yankee Hill Road at an estimated construction cost of approximately \$16,616,000 as shown in Table 4.4 below.

Table 4.4 Tier II Implementation - Estimated Costs Stevens Creek Basin Trunk Sewer City of Lincoln, Nebraska	
Phase	Estimated Project Costs
VI	\$3,384,000
VII	\$3,481,000
VIII	\$6,944,000
IX	\$2,807,000
Totals	\$16,616,000

The remaining areas located on the east side of the basin are located in Tier III areas. The construction in these areas would be substantially in the future. The flows from these areas have not been included in sizing of the west side trunk sewer for this project and would require a future parallel trunk sewer.

4.7.3 Accelerated Plan

For this plan, the construction of the trunk sewer would be accomplished by constructing one phase each year. Under this plan, Phase I would be constructed in 2005, Phase II would be constructed in 2006 and so on as outlined in Table 4.5 below.

Table 4.5 Accelerated Implementation Stevens Creek Basin Trunk Sewer City of Lincoln, Nebraska		
Phase	Year Constructed	Estimated Costs
I	2005	\$8,136,000
II	2006	\$6,032,000
III	2007	\$9,893,000
IV	2008	\$2,097,000
V	2009	\$10,047,000
VI	2010	\$3,384,000
VII	2011	\$3,481,000
VIII	2012	\$6,944,000
IX	2013	\$2,807,000

4.8 RECOMMENDED PIPE MATERIALS

Several pipe materials have been previously evaluated as documented in Technical Memorandum No. 5 (Appendix E) and summarized below. The selection of acceptable pipe materials for a project are based on many factors including but not limited to:

- Flow conditions including scour and anticipated amount of grit.
- Corrosion conditions, both internal and external.
- Flow requirements.
- Cost effectiveness.

- Strength and stiffness of pipe including unusual conditions such as railways and highways crossings.
- River crossings.
- The presence of groundwater.
- Points of turbulence such as junction structures and changes in direction and slope.
- Surrounding soils and geotechnical factors.
- Product history.
- Availability of materials.

The pipe materials shown in Table 4.6 are recommended for the Stevens Creek Basin Trunk Sewer project. However, there may be other pipe materials that are not listed that can be used as actual circumstances dictate. It is assumed that each design firm will select the pipe materials that, in their judgment, meet the specific project requirements for each phase and individual reach of the project.

Table 4.6 Summary of Recommended Pipe Materials Stevens Creek Basin Trunk Sewer City of Lincoln, Nebraska	
Pipe Material	Size
Reinforced Concrete Pipe RCP lined with PVC Sheet Liner	36 thru 84-inch Ø
Reinforced Concrete Cylinder Pipe lined with PVC Sheet Liner	36 thru 84-inch Ø
Prestressed Concrete Cylinder Pipe lined with PVC sheet Liner	36 thru 84-inch Ø
Centrifugally Cast Fiber Reinforced Mortar Pipe (HOBAS)	18 thru 84-inch Ø
Poly Vinyl Chloride (PVC)	18 thru 36-inch Ø

4.9 OTHER CONSTRUCTION ISSUES

4.9.1 Highways, Roads, Streets, and Railroads

The recommended alignment crosses several City, County, and State Roads. Construction in these areas will require close coordination with the respective representative. Special construction considerations including but not limited to pavement replacement and trenchless construction may be required in these areas. The actual requirements will be determined during final design.

The trunk sewer crosses the twin mainlines of the BNSF on the north side of Highway 6. This crossing will be constructed using trenchless construction. An application for the

construction of this crossing will be completed and delivered to the BNSF during the Phase I final design.

4.9.2 Farmland, Wetlands, and Grasslands

Contractors will be obligated to restore the ground surface to a condition equivalent to its pre-construction condition. Pre-construction conditions will be documented along the sewer pipe route by still photography. Farm operations may be continued over the buried pipeline after the project is completed. Where manholes and junction structures are located in farmland they will be protected with guard posts.

Other areas where land restoration may be required are areas designated as Native Grasslands or Wetlands. The actual restoration requirements in these areas will be determined in the final design process working in respective agencies.

4.9.3 Stream Crossings

The City is currently in the process of completing a watershed master plan for the Stevens Creek Basin. The consultants for the final design of the individual phases should review the Final Watershed Master Plan and coordinate any recommended improvements as necessary.

The areas where the trunk sewer crosses Stevens Creek, tributaries to Stevens Creek and drainage channels will also require special attention. It is recommended that in these areas the final design consultants work jointly with the watershed team to identify bio-engineered or other acceptable solutions to provide a stable streambed. Appropriate pipe protection should also be considered as part of this process.